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Meyer

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[54] **PROCESS AND APPARATUS FOR THE START-UP OF AN INSTALLATION FOR THE PRODUCTION OF INERT GASES**

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[52] **U.S. Cl.** ..... **23/230 A**; 23/232 E; 23/253 A; 23/254 E; 23/255 E; 23/281; 236/15 E; 431/6; 431/14

[51] **Int. Cl.²** .. **G01N 27/00**; B01J 7/00; F23N 5/24; F23N 1/00

[58] **Field of Search** .. 23/230 A, 253 A, 281, 232 E, 23/254 E, 255 E; 137/2, 3, 87; 431/6, 13, 14; 73/1 R, 23; 236/15 E; 252/372, 373 US

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[57] **ABSTRACT**

In the start-up of an installation for the production of an inert gas utilizing an analytical device for controlling the composition of the inert gas, the production of inert gas is initially controlled during a start-up period in accordance with predetermined and desired values. During the start-up period the analytical device is calibrated and after the start-up period, the calibrated analytical device is utilized for controlling the composition of the inert gas.

2 Claims, 2 Drawing Figures

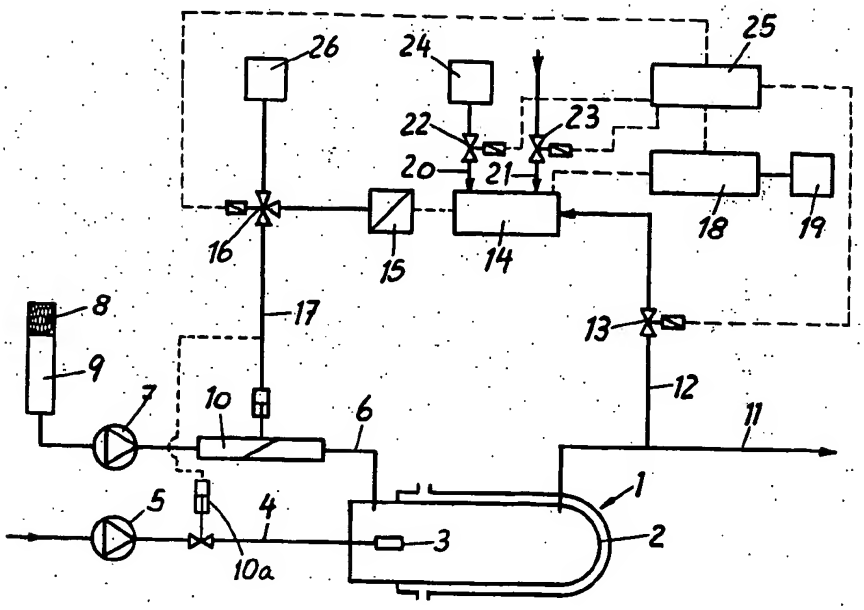

Fig. 1

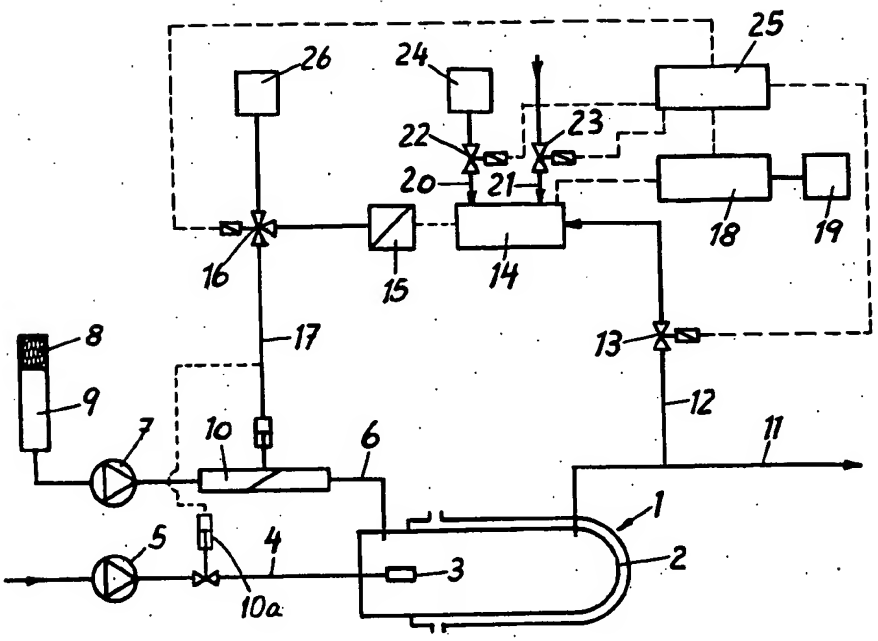
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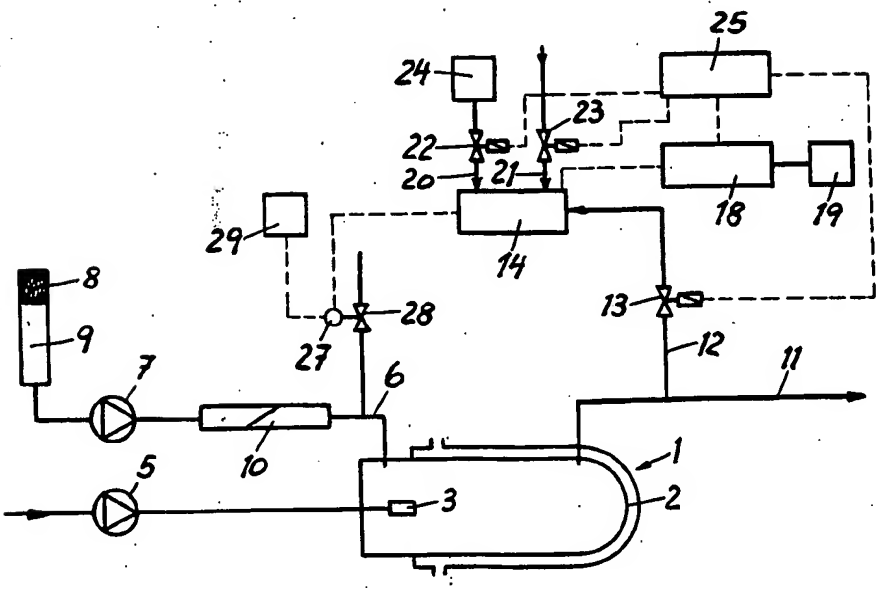
Fig. 2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PROCESS AND APPARATUS FOR THE START-UP OF AN INSTALLATION FOR THE PRODUCTION OF INERT GASES

BACKGROUND OF THE INVENTION

This invention relates to a process for the start-up of an installation for the production of inert gases where during normal production the introduction of air and/or the introduction of fuel is regulated in dependence on an analytical instrument for the produced inert gas. This invention also relates to apparatus for making such a process operable.

Certain conditions for the composition of an inert gas have to be fulfilled when producing it by burning various fuels as completely as possible. It has proven practical to control constantly the composition of the inert gases by aid of analytical instrumentation, and to regulate the introduction of air and/or fuel in correlation with such instrumentation because several factors (temperature, pressure, quality of fuel) are important for the combustion process. Such a regulation of the supply of air is known, for example from German DDS 1 667 613.

The start-up of installations for the production of inert gases by such a regulation has been found to be time consuming. The inert gas produced initially cannot be used for a relatively long time and must be blown off. Besides, all the known installations labor under the insecurity of calibrating the analytical instrumentation, particularly after prolonged shutdowns.

Such calibration has to be undertaken by an expert or highly skilled technician who might not be available at all times, particularly when the installation for the production of inert gases is situated upon a large tanker used for the transport of flammable gases liquefied at low temperature.

Accordingly, an object of the present invention is to overcome the disadvantages of known prior art arrangements and to provide a process for the start-up of an installation for the production of inert gases where, during normal operation, the supply of air and/or fuel is regulated as a function of an analytical instrument for the produced inert gases, and where the disadvantages heretofore described for the start-up stage are substantially overcome.

This objective is achieved, according to the present invention, by determining at the start-up the regulation of air or fuel intake by a previously fixed rate, and that during this phase the analytical installation is, preferably automatically, calibrated. This previously fixed rate may be chosen according to previous experience at such a range that the combustion occurs right after start-up under approximately optimal conditions. Concurrently with the startup of the burner there occurs the calibration of the analytical installation.

Practically, the calibration will be executed in such a way that the operation of the installation will be tested with air for maximum content of oxygen, and with oxygen free gas (for example, pure nitrogen) for minimum content of oxygen. After calibration the analytical installation is switched to normal operation, in other words, inert gas is introduced once the installation is correctly calibrated. The other components of the installation for the production of inert gases have meanwhile reached their correct conditions (temperature, pressure, etc.) so that at that moment the produced inert gases comply with the desired requirements. The introduction of air and fuel is preferably regulated pneumatically, and a device is provided for holding a previously fixed pressure. Thus the number of electrically regulated elements is kept comparatively small. A transducing installation must be arranged, of course, in order to transduce the electrical signals, furnished by the analytical installation, into pressure signals. Such a transducer may be dispensed with if the introduction of air and fuel is regulated by a valve furnished with a servomotor and the position of this valve at start-up is determined by a device which signals the predetermined value.

Other features which are considered characteristic of the invention are set forth in the appended claim.

Although the invention is illustrated and described in relationship to specific embodiments, it is nevertheless not intended to be limited to the details shown, since various modifications and structural changes may be made therein without departing from the spirit of the invention and within the scope and range of equivalents of the claims.

SUMMARY OF THE INVENTION

In starting up an installation for the production of an inert gas utilizing an analytical device for controlling the composition of the inert gas, the production of inert gas is initially controlled during a start-up period in accordance with predetermined and desired values independently of the actual composition of the inert gas being produced during such start-up period. During this start-up period the analytical device is calibrated and after the start-up period, the calibrated analytical device is utilized for controlling the composition of the inert gas.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a schematic view of an arrangement for controlling the production of inert gas according to one embodiment of the invention.

FIG. 2 is a schematic view similar to FIG. 1 of an alternate embodiment.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to the drawings in FIG. 1 the number 1 denotes a combustion chamber which is provided with a cooling jacket 2. Fuel is injected by means of a fuel pump 5 and conduit 4 which leads to a combustion nozzle 3. A blower 7 furnishes air through a conduit 6. The air is drawn in through a filter 8 and an intake muffler 9. A pneumatically activatable throttle 10 flap or valve, activated by air pressure is provided in the conduit 6 in order to regulate the air which is supplied to the combustion chamber 1.

Inert gas leaves the combustion chamber 1 through the conduit 11. At normal operating conditions of the installation a small portion of this inert gas is introduced into an analytical apparatus 14 through the conduit 12 by aid of an electromagnetically regulated valve 13. This arrangement produces, according to the composition of the inert gas, an electrical signal which is converted into a pressure signal by a transducer 15. The pressure signal thus regulates the throttle valve 10 by means of an electromagnetically actuated three-way valve 16 and a conduit 17.

A control apparatus 18 with an alarm generator 19 is provided for the calibration control. Furthermore

conduits 20 and 21 with electromagnetically regulated valves 22 and 23 are connected to the analytical apparatus 14, such conduits providing for the analytical apparatus 14 nitrogen from a container 24 of air.

An electronic control unit 25 is provided for the regulation of the process of calibration during start-up such control unit 25 being connected to the electrically actuatable valves (see the dashed lines in FIG. 1). A set-point device for controlling the throttle valve 10 during start-up is denoted with numeral number 26.

When the installation is started up (that is, switching on of fuel pump 5, of blower 7, and ignition of nozzle 3) the valve 13 is initially closed. Then the three-way valve 16 is acutated in such a way that the set point device 26 determines the position of the throttle valve 10 according to a previously fixed or pre-determined rate. As indicated hereinbefore, the fixed or predetermined rate may be chosen according to previous experience to provide an operating cycle such that the combustion right after start-up occurs under approximately optimal conditions. Simultaneously, the calibration control of the analytical apparatus begins in such a way, that consecutively nitrogen and air are introduced through the conduits 20 and 21 with the valves 22 and 23 respectively in order to calibrate for minimal and maximal content of oxygen. Signals originating from the analytical apparatus are checked by the control unit 18 with the alarm generator 19. After the end of the calibration control, the valves 22 and 23 are closed, the valve 13 is opened so that the inert gas, produced in the combustion chamber reaches the analytical apparatus 14. Simultaneously the three-way valve 16 is actuated in such a way that the electrical signal produced by the analytical apparatus 14 can actuate the throttle valve 10 through the current/pressure transducer. This method ensures that immediately after the end point of the calibration control, the inert gas conforms as to its composition to the desired values.

The analytical apparatus 14 can regulate either the introduction of air or the introduction of fuel. Another possibility of the regulation of the introduction of air is shown in FIG. 2. The throttle valve 10 remains unchanged in the embodiment of FIG. 2. An amount of air, larger than the amount needed for the combustion, flows through the throttle valve 10 per unit of time. Excess air is blown off through the valve 28 which is regulated by the analytical apparatus 14 by the aid of a servomotor 27. The originator for the desired position of the servomotor 27 at the start-up stage is denoted by the number 29.

While the invention has been described by means of specific examples and in specific embodiments, it is not intended to be limited thereto, for obvious modifications will occur to those skilled in the art without departing from the spirit and scope of the invention.

What is claimed is:

1. A process for the start-up of an inert gas producing device in which a fuel is completely burned with air and wherein, during regular operation which follows an initial start-up period, the supply of air or fuel to said gas producing device is controlled in response to the inert gas composition measured by a gas analyzer, the improvement comprising the steps of controlling the air or fuel supply to said inert gas producing device during said initial start-up period according to a set point, automatically and separately calibrating said analyzer during said start-up period, said step of automatically calibrating said analyzer during said start-up period comprising passing air through said analyzer for calibrating the maximum oxygen content and passing an oxygen-free inert gas through said analyzer for calibrating the minimum oxygen content, and then controlling said air or fuel supply by said analyzer, which has just been calibrated, after completion of said start-up period to provide for control of said air or fuel supply by said calibrated analyzer during said regular operation in place of said set point control.

2. Apparatus for use in an installation for the production of an inert gas in which the apparatus is initially operated during a start-up period followed by a period of regular operation, comprising an inert gas producing device, regulating means controlling the flow of fuel or air to said inert gas producing device to thereby control the inert gas being produced, start-up actuating means controlling said regulating means during said start-up period according to a set point, an analytical device for controlling said regulating means during said regular period of operation of said inert gas producing device in place of set point control by said start-up actuating means, calibrating means for calibrating said analytical device during said start-up period when said regulating means is being controlled by said start-up actuating means, a source of air connected to said analytical device for calibrating the maximum oxygen content, and a source of oxygen-free inert gas connected to said analytical device for calibrating the minimum oxygen content.

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